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Noteworthy Records, Range Extensions, and Conservation Status of Skunk Species in Texas

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Abstract

Voucher-based specimen records as well as well-substantiated photographic records help inform the distribution and conservation status of wildlife species. For the five skunk species (Family Mephitidae) that occur in Texas, documenting occurrence records through all available sources is vital to understanding the status of the species. In this survey of records, we report on: rabies-negative skunk specimens submitted to the Texas Department of State Health Services and deposited in the Angelo State Natural History Collections; specimens collected in association with field studies; specimens salvaged either as vehicle-killed animals or from wildlife rehabilitation facilities; and identifiable images from camera-trap studies. Research-grade observations from iNaturalist also were included from counties previously lacking a record. Finally, databases from systematic collections of mammals were searched for additional specimen records. Identification for most specimens was based on morphological features, but for specimens at potentially sympatric locations for *Spilogale interrupta* and *Spilogale leucoparia*, additional molecular analyses were used to confirm species. Reported herein are five county records and a range extension for *Conepatus leuconotus*, 39 county records for *Mephitis mephitis*, six county records and a range extension for *S. leucoparia*, and four county records for *S. interrupta*. Nonvouchered photographic records are presented for *C. leuconotus* (19), *Mephitis mephitis* (41), *S. leucoparia* (5), and *S. interrupta* (13). Also reported are five recent nonvouchered photographic records of *Mephitis macroura*, a species not confirmed in the state since 1999.

Key words: *Conepatus*, county records, distribution, Mephitidae, *Mephitis*, *Spilogale*, Texas

Introduction

Texas has the highest diversity of skunks (family Mephitidae) in the United States with five species: the White-backed Hog-nosed Skunk (*Conepatus leuconotus*), Hooded Skunk (*Mephitis macroura*), Striped Skunk (*Mephitis mephitis*), Desert Spotted Skunk (*Spilogale leucoparia*, formerly included in *S. gracilis*), and Plains Spotted Skunk (*Spilogale interrupta*, formerly included in *S. putorius*; Dragoo et al. 2003; McDonough et al. 2022; Schmidly and Bradley 2016). Despite this diversity of mephitids, the distribution of species such as *M. macroura* and *S. interrupta* and their conservation status in Texas remains uncertain.

Skunks, primarily *M. mephitis*, are important reservoirs of the rabies virus in Texas, which makes their distribution within Texas of even greater importance for public health and safety concerns (Oertli 2009; Texas Department of State Health Services 2020). The use of specimens submitted to the Texas Department of State Health Services (DSHS) for rabies testing has been important in identifying new mammal records in Texas, especially for bats (Demere et al. 2012; Krejsa et al. 2020; Krishnamoorthy et al. 2021).

Whereas some skunk species are common throughout much of Texas, there has been a lack of collection and accession of skunks by mammalogists in recent years. The lack of records could be a result of the unwillingness or inability of mammalogists to collect and prepare these species, or the lack of recent records may be influenced by lack of captures; however, at least two species (*S. interrupta* and *M. macroura*) appear to be decreasing on the Texas landscape (Schmidly and Bradley 2016). Our records indicate that in the preceding 25 years, only two *S. interrupta* specimens could be tied back to traditional survey or collection methodology (Edwards et al. 1998) while a third was collected by a student at Midwestern State University outside of official survey or collection trips. During the same period, multiple *S. interrupta* have been accessioned as vehicle-killed animals (Dowler et al. 2008; Shaffer et al. 2018) and many have been captured, samples taken for destructive sampling, and released without collection of a voucher (Shaffer et al. 2018; Perkins et al. 2021). With the rarity of collection efforts for skunks and the apparent rarity of some species in the state, the use of crowd-sourced data to update distribution maps can provide value, as recently noted with records of American Black Bears (*Ursus americanus*; Light et al. 2021). Additionally, iNaturalist (inaturalist.org), a global, multi-taxa citizen scientist platform, is increasingly being used to integrate community-generated data with professional science (Mesaglio and Callaghan 2021). Images from iNaturalist have been used to confirm presence and update the distribution of a rare mustelid in Colombia (deRoux et al. 2019), examine how traditional radio-telemetry compares with a citizen science approach to inform urban canine management (Mueller et al. 2019), and to address shortcomings in traditional specimen collection and curation (Heberling and Isaac 2018). Lastly, the widespread use of camera trapping by both researchers and citizen scientists has provided a wealth of information on animal behavior and distributions previously unavailable (Pesendorfer et al. 2018; Light et al. 2021; Perry et al. 2021). Use of iNaturalist or camera-trap images is especially valuable for large or medium-sized mammals, including skunks, whereas photo records for small mammals including shrews, small rodents, and bats are usually difficult or impossible to identify with certainty (Kays et al. in press). Although voucher-linked records are always preferred for the extended research use a specimen brings, well-supported nonvouchered photographic records provide important conservation insights.

The purpose of our study was to identify new records of skunk distribution in the state by using museum collection methods and other approaches to document pertinent occurrences. New county records of occurrence or changes in distribution are reported herein for four skunk species of Texas. For the fifth species, *M. macroura*, we provide evidence for its occurrence in Big Bend National Park.

METHODS

Records reported herein are partitioned into two broad categories: records supported by museum vouchers (*Specimens examined*) and photographs not supported by museum vouchers (*Nonvouchered photographic records*). Specimens examined is common terminology for voucher-supported material and can include skin, skull, skeleton, partial skeleton, and genetic vouchers. Nonvouchered photographic records herein include camera-trap images by researchers or the public, digital images of skunks captured and released or in a wildlife rehabilitation facility, and iNaturalist images that have been independently verified to species by researchers. Our photographic records of skunks are archived online and available for review, when otherwise not shielded due to Texas privacy concerns (iNaturalist 2021A; GBIF 2021). Although they are photographic only, we are confident that these nonvouchered records of skunks are sufficient for species

identification within the state of Texas. In all instances, however, vouchered mammal specimens continue to be essential for additional research purposes beyond establishing simple distributional presence.

Rabies-negative skunks from DSHS were examined and deposited as vouchered specimens in the Angelo State Natural History Collection (ASNHC). Skunk specimens from DSHS were submitted with only the head intact, thus sex was not determined. Additional specimens were collected as vouchers from field studies by permitted ASNHC staff or salvaged either as vehicle-killed animals or from wildlife rehabilitation facilities. Specimens were preserved as skins, skulls, skeletons, or in fluid. Catalog numbers are provided in the Results section for each specimen examined. Tissue samples (muscle, tongue, and/or heart, kidney, and liver) were taken if quality allowed. When available, standard measurements and sex were recorded.

Research-grade observations from iNaturalist were queried for county level records of each skunk species in Texas. Research-grade observations have a valid date and location, a photo, and are not of captive or cultivated organisms (iNaturalist 2021B). To achieve research-grade status, a minimum of two reviewers must agree on species identification and 67% of all reviewers must agree on species identification. All iNaturalist records were further reviewed by at least one author prior to inclusion. Any records with questionable species identification were removed. Although individual iNaturalist records can be queried on both iNaturalist and GBIF (GBIF 2021), the process is cumbersome. Therefore, all records were included in a single iNaturalist project to facilitate appropriate review and maintenance of records (iNaturalist 2021B), and each observation includes a unique identification number generated by iNaturalist, permanently linked to the record, and reported herein. If an iNaturalist record resulted in an accessioned voucher or if an individual county had both iNaturalist and voucher records, only the accessioned voucher record is reported here. Finally, the database aggregators and platforms iDigBio, VertNet, and Arctos were searched for additional vouchered records.

Although in parts of the United States spotted skunks (genus *Spilogale*) often are difficult to identify to species by morphology alone, the authors are confident that this is not the case in Texas. As there is a potential zone of sympatry within the central portion of the state (Dowler et al. 2008), however, additional analysis was performed to confirm species identification on four individuals. Two head-only specimens provided by DSHS and two additional specimens (road-mortality salvage and live capture) were analyzed using the mitochondrial cytochrome-b (cyt-b) gene sequence. All four specimens were from the zone of potential sympatry and were all *a priori* identified as *S. leucoparia* maternal lineage. DNA was extracted from heart or muscle tissue using DNeasy Blood and Tissue Kit (Qiagen Inc., Valencia, CA) protocols. Amplification and sequencing of the cyt-b gene were performed using standard PCR techniques and published primers LGL 765 F (Bickham et al. 1995) and LGL 766 R (Bickham et al. 2004). Sequences were compared to the GenBank (GB) database using a BLAST search to identify sequences with the highest similarity score and subsequently were submitted to GB for publication. GenBank identification numbers are reported with these records.

The presence and conservation status of both *S. interrupta* and *M. macroura* in Texas has been questioned (Schmidly and Bradly 2016). To further augment records, we identified recent research that reported on these species (*S. interrupta*: Perkins et al. in press; Shaffer et al. 2018; Perry et al. 2021; *M. macroura*: Stevens 2017). Camera-trap images were used to verify presence records of both species, and additional digital images were used to further verify *S. interrupta*. Perkins et al. (in press) and Perry et al. (2021) also reported on unverified records, such as observations. Of the records in Perkins et al. (in press) and Perry et al. (2021), we report herein only those that could be verified with detailed photographic images and specimens examined in natural history collections.

Identification of new county records was completed using distribution data provided by Schmidly and Bradley (2016) and recent accounts (Garcia et al. 2016; Halsey et al. 2018; Krishnamoorthy et al. 2021). Specific locality (i.e., below county level) is listed when known for specimens examined. Nonvouchered photographic records from iNaturalist are listed only at county level because of the potential for georeference error or because locality was obscured for privacy reasons. Records of *S. interrupta* on private lands

are reported only at county level due to Texas statute designed to protect landowners with threatened or endangered species on their property (Texas Government Code Section 403.454).

RESULTS AND DISCUSSION

Conepatus leuconotus (Lichtenstein, 1832)
White-backed Hog-nosed Skunk

Conepatus leuconotus can be distinguished from other skunks by the lack of a white spot or medial stripe between the eyes. In addition to the extended nose, the species can be identified by a single, wide white stripe that begins on the forehead and extends the length of the back and tail (Dragoo and Sheffield 2009). Within Texas, its range consists of *C. leuconotus leuconotus* in southern, western, and central Texas and a disparate, but presumed extinct, subspecies, *C. leuconotus telmalestes*, in southeastern Texas (Dragoo et al. 2003; Schmidly and Bradley 2016).

Five county records, including a range extension for the species, and three nonvouchered photographic records are reported here. A record from Briscoe County in 2009 extends the range of *C. l. leuconotus* by approximately 100 km north of its known distribution in the Texas Panhandle (Fig. 1). A record from Garza County also recently was reported (Halsey et al. 2018). Herein are other specimens examined from Bell, Edwards, Hood, and San Saba counties, all within the currently known distribution. Nonvouchered photographic records from iNaturalist in Blanco, Kendall, and Kinney counties are within the currently known distribution of the species.

The state of Texas lists *C. leuconotus* as a species of special conservation need but categorizes it as S4 (TPWD 2020). The category S4 is defined as "Apparently Secure: Uncommon but not rare; some cause for long-term concern due to declines or other factors." The consistent appearance of individuals killed by vehicles and on game cameras suggests that it is widely distributed and populations appear stable.

Specimens examined (7).—Bell County (1): 29 April 2014 (ASNHC 20031). Briscoe County (1): male, 4 June 2009, 9.2 km north, 11.6 km west of Silverton on TX HWY 207 (34.554221, -101.435619; ASNHC 16138). Edwards County (3): male, 24 October 1993, 6 km south of Edwards-Sutton county line on Route 277 (30.220729, -100.666578; ASNHC 12930); female, 16 March 2008, 61 km northeast of Del Rio on TX HWY 377 (29.793503, -100.627954; ASNHC 13538); male, 6 February 2015, north of Val Verde County line on TX HWY 277 (30.122737, -100.694652; ASNHC 17833). Hood County (1): 3 June 2011 (ASNHC 14849). San Saba County (1): 23 August 2012 (ASNHC 16470).

Nonvouchered photographic records (19).—Blanco County (12): 14 September 2016 (4109458); 20 March 2017 (5411795); 13 November 2017 (8797691); 28 November 2018 (18699497); 12 February 2019 (21539430); 2 December 2020 (66049785); 08 December 2020 (66323291); 16 December 2020 (66716938); 22 December 2020 (66922450); 23 December 2020 (66967526); 04 February 2021 (69042216); 14 March 2021 (71300046). Kendall County (3): 18 October 2014 (1025909); 23 September 2019 (33313743); 3 October 2019 (48581808). Kinney County (4): 2 October 2015 (2040687); 20 April 2017 (5873511); 12 October 2019 (34282008); 28 July 2020 (56424839).

Mephitis macroura Lichtenstein, 1832
Hooded Skunk

Mephitis macroura closely resembles *M. mephitis* but can be identified by its longer, softer fur and a distinct ruff of longer hair on the upper neck, as well as by its striping pattern. This skunk species is quite variable with three different color patterns: upperparts black with two narrow, lateral white stripes; upperparts mostly white, with a broad white band extending from between the eyes to the tail, and sides black; an intermediate phase with a single broad white band on the back and two narrow lateral white stripes. All three patterns share a thin, medial white stripe between the eyes (Ten Hwang and Larivière 2001; Schmidly and Bradley 2016).

Mephitis macroura occurs from Costa Rica north to the southwestern United States. In Texas, records of

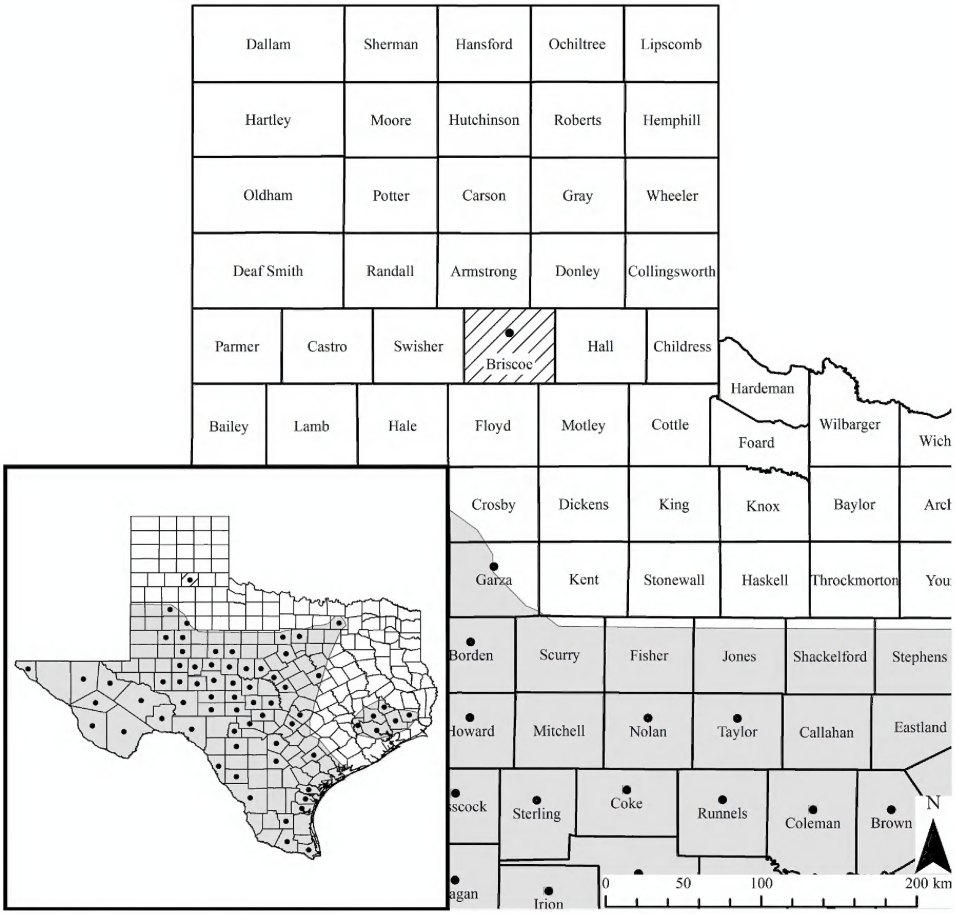

Figure 1. Distribution of *Conepatus leuconotus* in Texas (gray shading) adapted from Schmidly and Bradley (2016) with a new range extension (cross-hatched county) based on a voucher specimen collected approximately 100 km from the distribution of *C. leuconotus*. Black dots indicates county records.

the subspecies, *M. macroura milleri*, are known only from the Trans-Pecos region (Schmidly and Bradley 2016). The species is considered rare in Texas with a specimen last collected in 1999 (Yancey et al. 2017), leading some mammalogists to believe that *M. macroura* may be extirpated in Texas (Schmidly and Bradley 2016). We report on five recent observations from camera-trap data that document *M. macroura* in Big Bend National Park, Brewster County, Texas, within the past ten years. A camera-trap study in Big Bend National Park (Stevens 2017) revealed two records in 2014 (Fig. 2). A third image from a camera-trap survey on Mount Emory was taken in April 2019 (L. Ammerman, pers. comm.). Two images, one from February 2021 (not shown) and a second from June 2021 (Fig. 2) show *M. macroura* at Pine Canyon Spring. Although there are no iNaturalist observations of *M. macroura* in Texas, several are documented in the Mexican states of Chihuahua and Coahuila. Four confirmed iNaturalist observations of *M. macroura* are documented within

Figure 2. Camera-trap images of *Mephitis macroura* in Big Bend National Park, Brewster County, Texas: A) image taken near Mount Emory by L. K. Ammerman; B) image taken near Pine Canyon Spring by T. Athens and B. Masters; C) image taken near Juniper Canyon by S. Stevens; D) image taken near Mule Ears area by S. Stevens. These images present strong evidence of the species in Texas and warrant further investigation and verification with vouchered specimens.

50 km of the border with Texas in the last 10 years (11 September 2011 – 6 November 2019), supporting the liklihood of occupancy of the Hooded Skunk in Texas.

Because of its constrained distribution in Texas, *M. macroura* is listed as an S1S2 species of greatest conservation need, but has a global conservation status of G5 (TPWD 2020). S1S2 indicates "critically imperiled or imperiled" and G5 indicates "secure". *Mephitis macroura* should be considered rare in Texas, and further studies that consistently monitor vehicle-killed skunks or use camera-traps may provide a better assessment of the status of this species in the state.

Nonvouchered photographic records (5).—Brewster County, Big Bend National Park (5): 7 September 2014, Juniper Canyon; 13 October 2014, Mule Ears; 27 April 2019, Mount Emory; 5 February 2021, Pine Canyon Spring; 13 June 2021, Pine Canyon Spring.

Mephitis mephitis (Schreber, 1776)
Striped Skunk

Mephitis mephitis is distinguished by two white dorsal stripes that join on the neck and branch behind the head. A white medial stripe is present on the face and forehead (Wade-Smith and Verts 1982). Despite this standard pattern, there is remarkable variation in the pelage of this species with some individuals almost completely black and others with white over most of the body. Striped skunks are distributed throughout the state of Texas (Schmidly and Bradley 2016) with *M. m. varians* in the western majority of the state and *M. m. mesomelus* roughly east of the Balcones Fault

Zone (Schmidly 1983). In most areas where they occur sympatrically with other skunks, *M. mephitis* is the most abundant species (Schmidly and Bradley 2016). Despite state-wide distribution, some counties do not have a representative vouchered specimen or documented observation. Krishnamoorthy et al. (2021) reported a recent record from Lynn County located in the Texas Panhandle. Herein are documented 39 county records and 41 nonvounchered photographic records from 12 counties. One record from Wilson County was deposited as a voucher specimen at the Texas A&M Biodiversity Research and Teaching Collection – formerly Texas Cooperative Wildlife Collection (TCWC).

Specimens examined (149).—Armstrong County (1): 25 August 2020 (ASNHC 20162). Bee County (1): 2 August 2011 (ASNHC 15029). Bell County (1): female, 6 August 1996, Fort Hood Military Installation (ASNHC 11747). Bosque County (1): 15 July 2020 (ASNHC 20163). Burnet County (18): 9 November 2010 (ASNHC 16202); 6 September 2011 (ASNHC 19983); 7 March 2011 (ASNHC 14721); 7 March 2011 (ASNHC 14730); 12 April 2011 (ASNHC 16199); 12 May 2011 (ASNHC 14852); 3 June 2011 (ASNHC 15018); 21 June 2011 (ASNHC 16201); 7 July 2011 (ASNHC 15048); 6 September 2011 (ASNHC 19983); 27 January 2012 (ASNHC 15582); 3 February 2012 (ASNHC 16200); 8 July 2012 (ASNHC 15045); 12 February 2013 (ASNHC 18983); 21 February 2013 (ASNHC 19137); 12 June 2013 (ASNHC 17967); 12 September 2013 (ASNHC 17968); 1 April 2014 (ASNHC 17858). Carson County (9): 30 August 2010 (ASNHC 14427); 9 September 2010 (ASNHC 14450); 17 September 2010 (ASNHC 14438); 25 September 2010 (ASNHC 14439); 8 April 2011 (ASNHC 15583); 20 May 2011 (ASNHC 15022); 22 July 2011 (ASNHC 15040); 22 July 2011 (ASNHC 16211); 1 August 2011 (ASNHC 15030). Castro County (1): 16 May 2014 (ASNHC 17901). Childress County (2): 13 April 2011 (ASNHC 16212); 3 June 2011 (ASNHC 16637). Collingsworth County (1): 6 March 2012 (ASNHC 17854). Ector County (6): 11 October 2010 (ASNHC 14510); 12 November 2013 (ASNHC 17902); 17 September 2019 (ASNHC 20021); 17 September 2019 (ASNHC 20026); 26 September 2019 (ASNHC 20020); 27 September 2019 (ASNHC 20022). Fisher County (1): 30 November 2012 (ASNHC 18996). Gaines County (2): female, 10 September 2005, Seminole (32.718993, -102.64491; ASNHC 13637); female, 8 January 2008, 6.4 km southwest of Seminole on TX HWY 181 (32.678201, -102.693384; ASNHC 17835). Gillespie County (2): 12 August 2011 (ASNHC 20262); 23 August 2013 (ASNHC 18715). Gray County (1): 28 July 2020 (ASNHC 20164). Guadalupe County (5): 18 February 2011 (ASNHC 14613); 16 June 2011 (ASNHC 16220); 25 August 2011 (ASNHC 20027); 30 August 2011 (ASNHC 14423); 15 July 2014 (ASNHC 17913). Hamilton County (5): 26 July 2011 (ASNHC 15079); 16 October 2012 (ASNHC 16623); 20 March 2014 (ASNHC 17925); 27 March 2014 (ASNHC 18525); 4 April 2014 (ASNHC 17922). Hardeman County (1): 2 October 2012 (ASNHC 16186). Haskell County (1): 24 February 2020 (ASNHC 20165). Hood County (13): 26 October 2010 (ASNHC 14638); 25 May 2011 (ASNHC 16226); 21 September 2011 (ASNHC 16605); 6 December 2012 (ASNHC 18927); 20 March 2013 (ASNHC 20015); 12 June 2013 (ASNHC 17887); 12 June 2013 (ASNHC 18538); 14 February 2014 (ASNHC 18539); 11 March 2014 (ASNHC 17980); 22 April 2014 (ASNHC 18541); 24 June 2014 (ASNHC 19167); 6 August 2014 (ASNHC 18540); 2 October 2014 (ASNHC 19133). Johnson County (12): 22 October 2010 (ASNHC 14605); 27 December 2010 (ASNHC 14524); 1 March 2011 (ASNHC 14695); 10 January 2012 (ASNHC 16612); 6 June 2013 (ASNHC 18107); 8 June 2013 (ASNHC 18108); 25 June 2013 (ASNHC 17884); 3 January 2014 (ASNHC 20016); 20 February 2014 (ASNHC 17994); 9 April 2014 (ASNHC 17895); 23 December 2014 (ASNHC 19132); 2 October 2019 (ASNHC 20028). Lampasas County (1): male, 20 February 2011, 3.2 km east of Lampasas on TX HWY 183 (31.5317, -98.1181; ASNHC 19169). Live Oak County (1): 19 April 2011 (ASNHC 15139). Menard County (1): 12 November 2013 (ASNHC 17861). Midland County (8): 10 September 2010 (ASNHC 14443); 13 September 2010 (ASNHC 14447); 29 September 2010 (ASNHC 14568); 26 July 2011 (ASNHC 15031); 29 July 2011 (ASNHC 15041); 30 August 2012 (ASNHC 16383); 4 October 2013 (ASNHC 17856); 19 March 2014 (ASNHC 18549). Morris County (1): 30 January 2015 (ASNHC 18720). Ochiltree County (2): 21 October 2011 (ASNHC 16176); 18 March 2014 (ASNHC 17865). Parker County (11): male, 29 May 1999, 8 km southeast of Weatherford, Moncrief Ranch (32.699008, -97.722687; ASNHC 12075); male, 10 November 2001, 7.9 km south, 7.1 km east of Weatherford (32.678785, -97.707284; ASNHC 12011); female, 11 November 2001, 7.9 km south, 7.1 km east of Weath-

erford (32.678785, -97.707284; ASNHC 12010); female, 24 November 2001, 7.9 km south, 7.1 km east of Weatherford (32.678785, -97.707284; ASNHC 12009); 2 September 2010 (ASNHC 14530); 7 January 2011 (ASNHC 14774); 10 October 2012 (ASNHC 16624); 23 March 2012 (ASNHC 16387); 22 March 2013 (ASNHC 20018); 9 October 2014 (ASNHC 18885); 2 October 2019 (ASNHC 20025). Potter County (10): 31 August 2010 (ASNHC 14602); 08 February 2011 (ASNHC 14775); 06 May 2011 (ASNHC 15019); 12 July 2011 (ASNHC 15038); 11 October 2011 (ASNHC 16376); 09 August 2012 (ASNHC 20019); 11 December 2012 (ASNHC 18926); 11 December 2012 (ASNHC 18931); 16 June 2014 (ASNHC 18937); 20 June 2014 (ASNHC 18880). San Saba County (4): 10 March 2011 (ASNHC 14716); 23 August 2011 (ASNHC 20023); 26 February 2013 (ASNHC 18973); 5 June 2014 (ASNHC 18938). Scurry County (3): 14 June 2011 (ASNHC 155591); 9 September 2012 (ASNHC 16391); 14 September 2012 (ASNHC 16632). Somervell County (5): 15 September 2011 (ASNHC 16629); 22 March 2012 (ASNHC 16168); 22 March 2012 (ASNHC 16243); 9 April 2013 (ASNHC 20017); 26 March 2014 (ASNHC 18747). Stephens County (1): 30 April 2014 (ASNHC 18706). Upton County (2): May 2007, 0.32 km east of Rankin on US 67 (31.227126, -101.930772; ASNHC 13668); 9 June 2011 (ASNHC 16367). Uvalde County (2): 17 February 2011 (ASNHC 14706); 29 April 2011 (ASNHC 15092). Ward County (2): 16 October 2019 (ASNHC 20260); 18 October 2019 (ASNHC 20261). Wilson County (1): 5 February 2003, Floresville, Rancho de las Cabras, San Antonio Missions National Historical Park (29.28138889, -97.76055556; TCWC 58330). Winkler County (1): 4 March 2012 (ASNHC 14701). Wise County (7): 3 September 2010 (ASNHC 14508); 26 January 2012 (ASNHC 16173); 5 December 2012 (ASNHC 18871); 21 March 2013 (ASNHC 20263); 4 June 2013 (ASNHC 18743); 31 December 2019 (ASNHC 20265); 10 March 2020 (ASNHC 20264). Young County (2): 10 August 2011 (ASNHC 20030); 15 June 2012 (ASNHC 20029).

Nonvouchered photographic records (41).—Bandera County (2): 5 February 2019 (20131261); 4 June 2020 (48449557). Blanco County (18): 13 June 2009 (7532057); 3 January 2010 (9919814); 1 November 2011 (7457463); 13 August 2013 (364814); 27 January 2014 (513552); 5 May 2014 (662967); 11 November 2014 (1068625); 30 January 2015 (1202350); 2 February 2015 (1208175); 22 June 2016 (3501441); 16 June 2016 (7015996); 16 December 2016 (7015996); 10 May 2018 (12341382); 5 December 2018 (18846423); 17 December 2019 (37018434); 27 March 2020 (40804871); 25 May 2020 (47317064); 13 November 2020 (64811730); 19 December 2020 (66967656). Dawson County (1): 26 September 2020 (60858091). Foard County (9): 24 January 2016 (72920506); 1 March 2016 (67839090); 28 October 2017 (66598183); 29 October 2017 (66598190); 7 November 2017 (66598240); 23 November 2017 (66556365); 27 November 2017 (66553865); 2 December 2017 (66553873); 14 December 2017 (66553883). Goliad County (1): 16 February 2020 (38715761). Karnes County (1): 7 July 2020 (52324657). Kent County (2): 20 February 2018 (10221853); 6 March 2019 (21013966). Shackelford County (2): 19 October 2019 (34586391); 5 December 2020 (67767386). Shelby County (1): 1 May 2014 (663085). Stonewall County (2): 25 May 2017 (6363850); 13 March 2020 (41083160). Willacy County (1): 21 March 2020 (40452035). Zavala County (1): 4 December 2019 (36373326).

Spilogale leucoparia Merriam, 1890
Desert Spotted Skunk

Spotted skunks are distinguished from other mephitids by their smaller, weasel-like body and the presence of a large white spot on the forehead and multiple white stripes on the dorsum and sides of the body (Verts et al. 2001; Schmidly and Bradley 2016). One of the western forms of spotted skunk, *Spilogale leucoparia*, occurs in Texas from the southern part of the panhandle into southern Texas and from central Texas west into the Trans-Pecos region (Schmidly and Bradley 2016). *Spilogale gracilis* (= *S. leucoparia*) is listed as a Texas species of greatest conservation need, but at an S5 level of "Secure" (TPWD 2020).

A nonvouchered photographic record from Mills County, a specimen examined from Burnet County, and a newly recorded specimen examined in Travis County (previously nonvouchered photographic record, Morgan and Mueller 2014) represent eastern range extensions for the species (Fig. 3). Specimens examined from Hays, Sutton, and Upton counties are included in the distribution for the species. Molecular

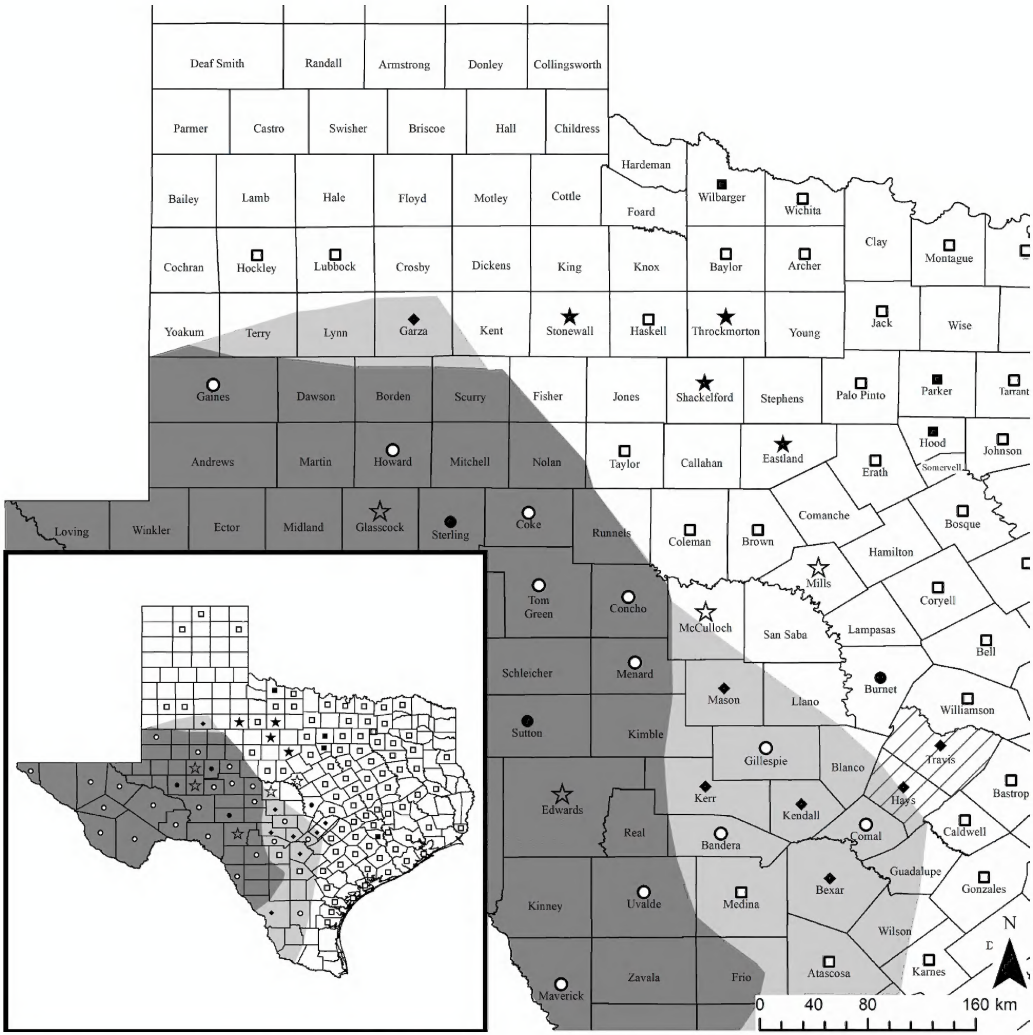

Figure 3. Range map adapted from Schmidly and Bradley (2016) of *Spilogale leucoparia* (dark gray), *S. interrupta* (white), and areas of potential range overlap (light gray) in Texas (inset). Map indicates previous county records within a single species' distribution (open circles – *S. leucoparia*, open squares – *S. interrupta*), new county records within a single species' distribution (closed circles – *S. leucoparia*, closed squares – *S. interrupta*), and county records where both species have been documented (black diamonds). Nonvouchered photographic records are symbolized by a white star for *S. leucoparia* and a black star for *S. interrupta*. Counties noted by crosshatch represent new *S. leucoparia* records where *S. interrupta* was previously documented.

analysis of four of the specimens examined confirmed that these were *S. leucoparia*. These records as well as others in the past 15 years (Dowler et al 2008; Morgan and Mueller 2014; Garcia et al. 2016) suggest a shift eastward in the range of *S. leucoparia* in Texas (Fig. 3). In these areas, future research should determine if both spotted skunk species are maintaining sympatric distributions or whether *S. leucoparia* is locally displacing *S. interrupta*.

Specimens examined (7).—Burnet County (1): male, 3 February 2019, Marble Falls, 400 3rd Street (30.569164, -98.272018; ASNHC 20032, GB accession number MZ558542). Hays County (2): 13 June 2014 (ASNHC 18895); male, 4 August 2019, San Marcos, TX RR 32, ~1.5 km west of junction with TX RR 12 (29.939275, -98.106862; ASNHC 20033, GB accession number MZ558543). Sterling County (1): male, 17 July 2020 (ASNHC 20267). Sutton County (1): male, 11 April 2016, 7.7 km north of Sonora on HWY 277 (30.636528, -100.643427; ASNHC 19173, GB accession number MZ558541). Travis County (1): 12 June 2014 (ASNHC 18947, GB accession number MZ547038). Upton County (1): 25 August 2015 (ASNHC 20034).

Nonvouchered photographic records (5).—Edwards County (1): 13 November 2017 (68236476). Glasscock County (1): 22 August 2017 (7623291). McCulloch County (1): 29 August 2017 (7714786). Mills County (1): 1 May 2020 (49959626). Reagan County (1): 2 July 2016 (3620247).

Spilogale interrupta **(Rafinesque 1820)**
Plains Spotted Skunk

Spilogale interrupta occurs from the northeastern panhandle to extreme southern Texas and from eastern Texas through the eastern extent of the Edwards Plateau (Schmidly and Bradley 2016). The species can be distinguished from *S. leucoparia* by less white in the tail, a smaller forehead spot, and more extensive black coloration on the dorsum (Schmidly and Bradly 2016, Figure 128). Since the 1940s, the species experienced a range-wide population decline (Gompper and Hackett 2005; Gompper 2017) and it is ranked as a S1S3 (vulnerable, imperiled, or critically imperiled) species of greatest conservation need in Texas (TPWD 2020). Although *S. interrupta* appears to be uncommon in Texas, a recent study revealed viable populations in the Katy Prairie region of Harris and Waller counties and at Fort Hood Military Installation in Coryell and Bell counties (Perkins et al. in press). Moreover, Perry et al. (2021) reported verified presence data from 31 Texas counties (data range 2000–July 2020) and unverified presence data from five counties. Additional information on four county and four nonvouchered photographic records, all within the known range of the species in Texas, is reported here (Fig. 3).

Three neonates were reported via wildlife rehabilitation records from Austin County; two subsequently died and were salvaged as specimens. A vehicle-killed skunk was salvaged from Parker County. A rabies-negative head was submitted by DSHS from Hood County. A partial coding sequence of the mitochondrial cytochrome-b (cyt-b) gene was sequenced from a tissue-only sample from Wilbarger County (Shaffer et al. 2018). Five individuals were captured and relocated from inside a private business in Eastland County and are reported as nonvouchered photographic records. One individual was detected by camera-trap in Shackelford County; because of camera malfunction, date for this record is listed as the two-week period between camera deployment and check. At least one individual was detected twice at spatially disjunct camera-traps in Stonewall County. Four neonates and 1 adult were reported via wildlife rehabilitation records from Throckmorton County (Perry et al. 2021).

Specimens examined (5).—Austin County (2): male, 29 June 2020 (ASNHC 20076); female, 29 June 2020 (ASNHC 20266). Hood County (1): 10 October 2019 (ASNHC 20024). Parker County (1): male, 06 April 2020, ca.3.5 km N Cresson on US 377 (32.560995, -97.605203 ASNHC 20854). Wilbarger County (1): 14 March 2016, Vernon, 1.1 km east of Main Street on HWY 70 (34.159324, -99.271481; ASK 11913; GB accession number MG753585.1).

Records reported in Perry et al. 2021 (13).—Eastland County (5): 05 October 2017. Shackelford County (1): 16 – 31 October 2016. Stonewall County (2): 10 August 2018; 24 September 2018. Throckmorton County (5): 08 August 2018 (4 female, 1 male).

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LITERATURE CITED

Bickham, J. W., C. C. Wood, and J. C. Patton. 1995. Biogeographic implications of cytochrome b sequences and allozymes in sockeye (*Oncorhynchus nerka*). Journal of Heredity 86:140–144.

Bickham, J. W., J. C. Patton, D. A. Schlitter, I. L. Rautenbach, and R. L. Honeycutt. 2004. Molecular phylogenetics, karyotypic diversity, and partition of the genus *Myotis* (Chiroptera: Vespertilionidae). Molecular Phylogenetics and Evolution 33:333–338.

Demere, K. D., A. M. Lewis, B. Mayes, R. J. Baker, and L. K. Ammerman. 2012. Noteworthy county records for 14 bat species based on specimens submitted to the Texas Department of State Health Services. Occasional Papers, Museum of Texas Tech University 315:1–14.

deRoux, J. M., E. A. Noguera-Urbano, and H. E. Ramírez-Chaves. 2019. The vulnerable Colombian weasel *Mustela felipei* (Carnivora): a new record from Colombia and a review of its distribution in protected areas. Therya 10:207–210.

Dowler, R. C., C. E. Ebeling, G. I. Guerra, and A. W. Ferguson. 2008. The distribution of spotted skunks, genus *Spilogale*, in Texas. Texas Journal of Science 60:321–326.

Dragoo, J. W., R. L. Honeycutt, and D. J. Schmidly. 2003. Taxonomic status of white-backed hog-nosed skunks, genus *Conepatus* (Carnivora: Mephitidae). Journal of Mammalogy 84:159–176.

Dragoo, J. W., and S. R. Sheffield. 2009. *Conepatus leuconotus* (Carnivora: Mephitidae). Mammalian Species 827:1–8.

Edwards, C. W., R. C. Dowler, and D. S. Carroll. 1998. Assessing medium-sized mammal abundance at Fort Hood Military Installation using live-trapping and spotlight counts. Occasional Papers, Museum of Texas Tech University 185:1–23.

Garcia, C. J., et al. 2016. New distributional records of mammals in Texas. Occasional Papers, Museum of Texas Tech University 343:1–8.

GBIF.org (GBIF). 2021. GBIF Occurrence Download https://doi.org/10.15468/dl.wkdmey. Accessed 13 July 2021.

Gompper, M. E. 2017. Range decline and landscape ecology of the eastern spotted skunk. Pp. 478–492 in Biology and conservation of the musteloids (D. W. Macdonald, C. Newman, and L. A. Harrington, eds.). Oxford University Press, Oxford, United Kingdom.

Gompper, M. E., and H. M. Hackett. 2005. The long-term, range-wide decline of a once common carnivore: the eastern spotted skunk. Animal Conservation 8:195–201.

Halsey, M. K., et al. 2018. New distributional records of mammals in Texas: Orders Chiroptera, Carnivora, and Rodentia. Occasional Papers, Museum of Texas Tech University 354:1–8.

Heberling, J. M., and B. L. Isaac. 2018. iNaturalist as a tool to expand the research value of museum specimens. Applications in Plant Science 6:1–8.

iNaturalist. 2021A. Noteworthy records, range extensions, and conservation status of skunk species in Texas. https://www.inaturalist.org/projects/noteworthy-records-range-extensions-and-conservation-status-of-skunk-species-in-texas. Project created 11 July 2021.

iNaturalist. 2021B. Frequently asked questions: What is the data quality assessment and how do observations qualify to become "Research Grade"? https://

www.inaturalist.org/pages/help#quality. Accessed 12 July 2021.

Kays, R., et al. in press. Which mammals can be identified from camera traps and crowd-sourced photographs? Journal of Mammalogy.

Krejsa, D. M., S. K. Decker, and L. K. Ammerman. 2020. Noteworthy records of 14 bat species in Texas including the first record of *Leptonycteris yerbabuenae* and the second record of *Myotis occultus*. Occasional Papers, Museum of Texas Tech University 368:1–12.

Krishnamoorthy, M. A., et al. County records for 20 mammal species across Texas from the Orders Cingulata, Lagomorpha, Soricomorpha, Chiroptera, Carnivora, and Rodentia. Occasional Papers, Museum of Texas Tech University 372:1–12.

Light, J. E., A. S. Keane, and J. W. Evans. 2021. Updating the distribution of American black bears (*Ursus americanus*) in Texas using community science, state agencies, and natural history collections. Western North American Naturalist 81:396–406.

McDonough, M. M., A. W. Ferguson, R. C. Dowler, M. E. Gompper, and J. E. Maldonado. 2022. Phylogenomic systematics of the spotted skunks (Carnivora, Mephitidae, *Spilogale*): additional species diversity and Pleistocene climate change as a major driver of diversification. Molecular Phylogenetics and Evolution 167:10726.

Mesaglio, T., and C. T. Callaghan. 2021. An overview of the history, current contributions and future outlooks of iNaturalist in Australia. Wildlife Research 48:289–303.

Morgan, D. T., and J. M. Mueller. 2014. A noteworthy record of the western spotted skunk (*Spilogale gracilis*) in Travis County, Texas. Texas Journal of Science 66:21–22.

Mueller, M. A., D. Drake, and M. L. Allen. 2019. Using citizen science to inform urban canid management. Landscape and Urban Planning 18:362–371.

Oertli, E. H., P. J. Wilson, P. R. Hunt, T. J. Sidwa, and R. E. Rohde. 2009. Epidemiology of rabies in skunks in Texas. Journal of the American Veterinary Medical Association 234:616–620.

Perkins, J. C., A. A. Gibson, B. D. Wolaver, B. J. Labay, J. P. Pierre, and R. C. Dowler. In press. An evaluation of detection methods for the plains skunk. Wildlife Society Bulletin.

Perkins, J. C., K. P. Jefferson, M. H. Hamilton, R. D. Dowler, and R. D. Stevens. 2021. Effects of seasonality and bait type on capture efficacy and sex ratio of plains spotted skunks. Southeastern Naturalist 20:241–251.

Perry, R. W., D. B. Sasse, J. C. Perkins, and N. W. Sharp. 2021. Distribution and relative abundance of eastern spotted skunk records across their range. Southeastern Naturalist 20:13–23.

Pesendorfer, M. B., S. Dickerson, and J. W. Dragoo. 2018. Observation of tool use in striped skunks: how community science and social media help document rare natural phenomena. Ecosphere 9:1–5.

Schmidly, D. J. 1983. Texas mammals east of the Balcones Fault Zone. Texas A&M University Press, College Station.

Schmidly, D. J., and R. D. Bradley. 2016. The mammals of Texas. 7th edition. The University of Texas Press, Austin.

Shaffer, A. A., R. C. Dowler, J. C. Perkins, A. W. Ferguson. M. M. McDonough, and L. K. Ammerman. 2018. Genetic variation in the eastern spotted skunk (*Spilogale putorius*) with emphasis on the plains spotted skunk (*S. p. interrupta*). Journal of Mammalogy 99:1237–1248.

Stevens, S. 2017. Distribution and habitat selection of carnivores in Big Bend National Park, Texas. M.S. thesis, Sul Ross State University, Alpine, Texas.

Ten Hwang, Y., and S. Larivière. 2001. *Mephitis macroura*. Mammalian Species 686:1–3.

Texas Department of State Health Services Zoonosis Control. 2020. Rabies prevention in Texas. https://www.dshs.texas.gov/IDCU/disease/rabies/information/prevention/Pamphlet/prevention.pdf. Accessed 12 July 2021.

Texas Parks and Wildlife Department (TPWD). 2020. Species of greatest conservation need. https://tpwd.texas.gov/huntwild/wild/wildlife_diversity/nongame/tcap/sgcn.phtml. Accessed 12 July 2021.

Verts, B. J., L. N. Carraway, and A. Kinlaw. 2001. *Spilogale gracilis*. Mammalian Species 674:1–10.

Wade-Smith, J., and Verts, B. J. 1982. Mephitis mephitis. Mammalian Species 173:1–7.

Yancey, F. D. II, R. W. Manning, J. R. Goetze, L. L. Lindsey, R. D. Bradley, and C. Jones. 2017. The hooded skunk (*Mephitis macroura*) from the Davis Mountains of West Texas: natural history, morphology, molecular characteristics, and conservation status. Texas Journal of Science 69:87–95.

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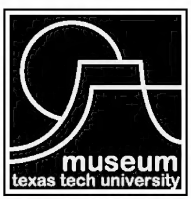

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